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EXAMINER	
PHAM, THOMAS K	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/904,168	Applicant(s) HARMSE, MAGIEL J.
	Examiner Thomas K Pham	Art Unit 2121

-- The MAILING DATE of this communication app ars on the cover sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 July 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-86* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-86* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

Notice to Applicant(s)

1. Claims 1-86 of U.S. Application 09/904168 filed on 07/12/2001 are presented for examination.

DETAILED ACTION

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-8, 10-15, 17-19, 29-32, 39-47, 49-54, 56-58, 68-70, 78-80, 83 and 85 are rejected under 35 U.S.C. 102(b) as being anticipated by Mozumder et al. U.S. Patent no. 5,408,405 (hereinafter Mozumder).

Regarding claim 1, 39, 78 and 85

Mozumder teaches

A method of modeling a process system comprising the steps of:

a. modeling a subject process system with an initial model (col. 4 line 65 to col. 5 line 9, "let y_1, y_2 be ... terms in f_i") ;

b. coupling to the subject process system a multivariable process control system that utilizes said initial model, to control the subject process system (col. 3 lines 19-23, "Using model based SQC ... have changed state");

c. tuning said multivariable process control system for stable operation of the subject process system (col. 3 lines 25-29, "a model tuner ... the tuning problem."; and

d. using data generated from said multivariable process control system, generating an improved model of the subject process system, said steps of tuning and generating effectively perturbing the subject process system to generate data for model identification of the subject process system (col. 4 lines 45-53, "In this controller ... equipment state.").

Regarding claim 2 and 40

Mozumder teaches

- repeating steps (b) through (d) with said improved model as the initial model such that a further improved model is generated (col. 2 lines 28-32, "repeating the tuning ... are not acceptable").

Regarding claim 3 and 41

Mozumder teaches

- the steps of tuning and generating are accomplished in parallel with step testing (col. 4 lines (col. 4 lines 37-43, "Estimating the state ... update the coefficients").

Regarding claim 4, 42 and 43

Mozumder teaches

- any combination of the steps is done remotely via a high speed communication link and digital processor, such that a reduction in engineering supervision is enabled (col. 1 lines 64-66, "The tuned models ... automatically adjust the recipe.".

Regarding claim 5 and 45

Mozumder teaches

- the multivariable process control system employs a constrained, model-based controller (col. 8 lines 29-31, "constraint had to be ... initial models if PECVD").

Regarding claim 6 and 44

Mozumder teaches

- wherein step (a) of modeling said subject process system includes one of: using an existing model from a potentially different but similar process system; deriving a model from a non-model based process control system; deriving a model from a manual step test of said subject process system; and deriving a model from engineering knowledge of said subject process system (col. 3 lines 19-33, "Using model based SQC ... the equipment settings.").

Regarding claim 7 and 46

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes the multivariable process control system employing an explicit or implicit model, where an explicit model is a model describable by a mathematical equation, and where an implicit model is a model not describable by a mathematical equation (col. 5 lines 55-64, "The corresponding tuned models ... need for tuning.").

Regarding claim 8 and 47

Mozumder teaches

- wherein said multivariable process control system employs at least one of: sliding mode control; switching mode control structures; and variable structure control (col. 11 line 68 to col 12 line 2, "nonlinearities and cross ... experience, or intuition.").

Regarding claim 10 and 49

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes computing process control action for controlled variables and manipulated variables in accordance with an objective function J (col. 6 lines 24-45, "Equation 3 and 4 ... kth monitor wafer.").

Regarding claim 11 and 50

Mozumder teaches

- objective function J is extremized (col. 6 lines 24-45, "Equation 3 and 4 ... kth monitor wafer.").

Regarding claim 12 and 51

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes using target values calculated via a robust steady-state target calculation (col. 6 lines 8-10, "for stable processes ... strongly correlated.").

Regarding claim 13, 52, and 79

Mozumder teacher

- wherein step (b) of coupling to said subject process system includes augmenting the initial model with shadow system controlled variables, where shadow system controlled variables are mathematically and functionally equivalent to system manipulated variables which may be treated as system controlled variables (col. 8 lines 28-66, "constraints had to be ... output parameters").

Regarding claim 14, 53 and 80

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes moving or stepping one or more system manipulated variables or said shadow system controlled variables simultaneously (col. 2 lines 9-14, "utilizing process models ... plurality of products.").

Regarding claim 15 and 54

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes moving or stepping one or more system manipulated variables or said shadow system controlled variables for a fixed or varying amounts of time (col. 3 lines 50-53, "Fewer measurements ... less stable process.").

Regarding claim 17 and 56

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes normalizing a system manipulated variable-system controlled variable gain relation to unity and using the normalized gain relation as the shadow system controlled variable (col. 5 line 48 to col. 6 line 7, "The variables s_1^2 and s_2^2 ... becomes under-constrained.").

Regarding claim 18 and 57

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes adjusting shadow system controlled variables targets to prevent shadow system controlled variables from violating subject process control variable limits (col. 8 lines 20-28, "Once the models ... output parameters.").

Regarding claim 19 and 58

Mozumder teaches

- wherein said step of controlling equivalent system manipulated variables is in accordance with one of: an objective function J; a simultaneous moving of one or more shadow system controlled variables or system manipulated variables; for an amount of time, moving of one or more shadow system controlled variables or system manipulated variables; a superimposed PRBS sequence; a normalized system manipulated variable-system controlled variable gain, the normalized gain being normalized to unity and used as the shadow system controlled variable; and an adjustment of shadow system controlled variables targets to prevent shadow system controlled variables from violating subject process control variable limits (col. 8 lines 20-28, "Once the models ... output parameters.").

Regarding claim 29, 68 and 83

Mozumder teaches

- wherein step (b) of coupling to said subject process system includes calculating suitable targets for system manipulated variables of the subject process system (col. 8 lines 20-24, "Once the models ... target output values.").

Regarding claim 30 and 69

Mozumder teaches

- wherein said suitable targets for system manipulated variables are chosen manually by a human operator (col. 3 lines 30-33, "This process determines ... equipment settings.").

Regarding claim 31 and 70

Mozumder teaches

- wherein said suitable targets for system manipulated variables are determined by one of: a middle value of process control limit values for controlled variables of the subject process system; a partial least squares analysis (col. 8 lines 63-68, "The weighted least-squares ... used as weights)."); a principle components analysis; and a value furthest away from process control limit values of both manipulated variables and controlled variables of the subject process system.

Regarding claim 32

Mozumder teaches

- wherein the suitable targets for system manipulated variables are automatically determined and implemented by a digital processing system, in a manner that enables reduction of engineering supervision (col. 1 lines 64-66, "The tuned models .. adjust the recipe.").

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 9, 48, 34, 35, 72 and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder U.S. Patent no. 5,408,405.

Regarding claim 9 and 48

Mozumder teaches a method as claimed in step (b) of coupling to said subject process system but does not teach the system includes constructing and controlling equivalent system manipulated variables, where values of said equivalent system manipulated variables are equal to the initial model predicted values when controlled variables of the subject process system are within subject process limit values. However, it would be obvious to one of ordinary in the art to have the manipulated variables to be the same as the initial model predicted values because if the process system are within the limit values before conducting any tuning or manipulation, then the predicted values of the initial model is also the manipulated variables for the controller.

Regarding claim 34 and 72

Mozumder teaches a method as claimed in step (c) of tuning said multivariable process control system but does not teach the tuning includes adjusting internal variables of the multivariable process control system in a manner that improves process control action and ensures process system safety. However, it would be obvious to one of ordinary skill in the art to include safety feature as a number one priority in any design or improving controlled process. Furthermore, the predefined operating upper and lower limit of the internal variables is already a guaranty for safety.

6. Claims 35 and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Surauer et al. U.S. Patent no. 5,042,752 (hereinafter Surauer).

Regarding claim 35 and 73

Mozumder teaches a method as claimed with control action of the multivariable process control system and disturbances of the subject process system but does not teach the adjusting reduces

feedback correlation of control system and disturbance. However, Surauer teaches the adjusting reduces the disturbances to increase accuracy (col. 13 lines 15-18, "form a measure for ... increasing the accuracy."). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to incorporate the adjusting feature of Surauer with the multi-variable process controller of Mozumder because it would provide for reducing the feedback correlation of the multivariable process control system and the disturbances in order to increase the accuracy of the control parameters obtained to operate the subject process system.

7. Claims 16, 55 and 81 rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Lim et al. U.S. Patent no. 5,457,625 (hereinafter Lim).

Regarding claim 16, 55 and 81

Mozumder teaches a method as claimed in step (b) of coupling to said subject process system with the system manipulated variables and said shadow system controlled variables but does not teach the step includes superimposing a pseudo-random binary sequence (PRBS). However, Lim teaches a pseudo-random binary noise test (PRBN) (col. 10 lines 43-51, "one such test ... model is generated."). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to incorporate the PRBN of Lim with the multi-variable process controller of Mozumder because it would provide for generating a random signal having specific amplitude in order to superimpose a testing procedure that records the movements of the manipulated variable and generates a dynamic model.

8. Claims 20-26, 36-37, 59-65, 74-75 and 82 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Surauer U.S. Patent no. 5,042,752.

Regarding claim 20, 59 and 82

Mozumder teaches a method as claimed in step (b) of coupling to said subject process system of the multivariable process control system but does not teach the step includes imposing a dead zone on controlled variables. However, Surauer teaches imposing a dead zone on controlled variables (col. 14 lines 9-.14, "The dead zone (405) ... are exceeded."). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to incorporate the imposing of a dead zone of Surauer with the multi-variable process controller of Mozumder because it would provide for imposing a dead zone to the output signal of the controller in order to furnish an output signal only if predetermined threshold values are exceeded.

Regarding claim 21 and 60

Surauer teaches the dead zone is computed by accumulating relatively small manipulated variable control action from said multivariable process control system and implementing the control action when summed control action reaches a predefined threshold (col. 14 lines 16-19, "the response thresholds ... superimposed nutation oscillations.")

Regarding claim 22 and 61

Surauer teaches the controlled variables are filtered to attenuate high frequency noise (col. 32 lines 5-17, "a high-pass filter ... in such a case.").

Regarding claim 23 and 62

Surauer teaches the dead zone is generated by modifying mathematical formulation of the

multivariable process control system (col. 21 line 51 to col. 22 line 51, "it is proposed for ... the dead zone/modulation member 506)").

Regarding claim 24 and 63

Mozumder teaches the mathematical formulation employs discrete or binary system manipulated variables (col. 2 lines 45-47, "The invention is described ... discrete manufacturing.").

Regarding claim 25 and 64

Surauer teaches the dead zone is generated by an analogue to digital converter (col. 15 lines 46-49, "the realization of such ... analog circuits.").

Regarding claim 26 and 65

Surauer teaches the dead zone is generated by pulse width modulation (col. 14 lines 36-44, "more simply realizable ... such a modulator").

Regarding claim 36 and 74

Mozumder teaches a method as claimed in step (b) of coupling to said subject process system but does not teach the step includes computing process control action in accordance with subject process variable limit values and subject process system disturbances, wherein subject process system disturbances are unmeasured extraneous influences affecting the subject process system and not captured in the initial model. However, Surauer teaches computing process control action in accordance with subject process variable limit values and subject process system disturbances, wherein subject process system disturbances are unmeasured extraneous influences affecting the subject process system and not captured in the initial model (col. 21 lines 51-62, "it is proposed for ... of the vehicle."). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to incorporate the adjusting feature of Surauer with the

multi-variable process controller of Mozumder because it would provide for computing the process control action in order to increase the accuracy of the control parameters obtained to operate the subject process system.

Regarding claim 37 and 75

Mozumder teaches a method as claimed with control action of the multivariable process control system and disturbances of the subject process system but does not teach the adjusting reduces feedback correlation of control system and disturbance. However, Surauer teaches the adjusting reduces the disturbances to increase accuracy (col. 13 lines 15-18, "form a measure for ... increasing the accuracy."). Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to incorporate the adjusting feature of Surauer with the multi-variable process controller of Mozumder because it would provide for reducing the feedback correlation of the multivariable process control system and the disturbances in order to increase the accuracy of the control parameters obtained to operate the subject process system.

9. Claims 27-28 and 66-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Gabriel U.S. Patent no. 3,934,124.

Regarding claim 27 and 66

Mozumder teaches a method as claimed in step (b) of coupling to said subject process system but does not teach the system includes creating a time varying, almost periodic limit cycle of manipulated variables of the subject process system. However, Gabriel teaches the system includes creating a time varying, almost periodic limit cycle of manipulated variables of the process system (col. 5 lines 41-46, "Without the addition ... response signal."). Therefore, it

would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the limit cycle of Gabriel with the multi-variable process controller of Mozumder because it would provide for avoiding the impermissible limiting cycle vibrations which can occur under the most unfavorable conditions due to a discrete regulating intervention.

Regarding claim 28 and 67

Gabriel teaches system controlled variables are filtered to attenuate low frequency noise (col. 6 line 63 to col. 7 line 5, "If the noise signal ... noise generator").

10. Claims 33 and 71 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder U.S. Patent no. 5,408,405 in view of Mozumder et al U.S. Patent no. 5,546,312.

Regarding claim 33 and 71

Mozumder teaches a method as claimed but does not teach the manipulated variables are stepped or moved in a random way about the suitable targets while keeping said manipulated variables and controlled variables of the subject process system within process control limit values. However, Mozumder et al. teaches an independent random variable that moved about suitable targets while keeping the process within allowed tolerances (col. 7 lines 63-67, "The objective is to ... violating any constraints."). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the random variable of Mozumder et al. with the multi-variable process controller of Mozumder because it would provide for randomly adjust the manipulated variables about the targets within a control limit values in order to further optimized the control parameters.

11. Claims 38 and 76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Dahlin U.S. Patent no. 3,534,400.

Regarding claim 38 and 76

Mozumder teaches a method as claimed wherein step (d) of using data and generating an improved model but does not teach the step includes using a system identification algorithm and analyzing values of manipulated variables and controlled variables of the subject process system to create an improved model. However, Dahlin teaches the step includes using a system identification algorithm and analyzing values of manipulated variables and controlled variables of the subject process system to create an improved model (col. 10 lines 1-2, "In the above ... selected as the best."). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the identification algorithm of Dahlin with the multi-variable process controller of Mozumder because it would provide for identifying all the process characteristics or parameters in order to supply accurate identified parameters to a model when various adverse factors are taken into consideration.

12. Claims 77, 84 and 86 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozumder in view of Scoddard et al. U.S. Patent no. 6,587,744.

Regarding claim 77, 84 and 86

Mozumder teaches an apparatus as claimed with the multivariable process controller but does not teach the controller includes a closed-loop process control system that generates values for manipulated variables and controlled variables of the subject process system for model identification; and the generated data includes an open-loop process control system. However,

Scoddard teaches a closed-loop process control system that generates values for manipulated variables and controlled variables (col. 12 lines 25-31, " The closed-loop feedback ... of Process Tool A"); and the generated data includes an open-loop process control system (col. 11 lines 4 lines 4-10, "For feed-forward ... completely open loop."). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the closed-loop and open loop of Scoddard with the multi-variable process controller of Mozumder because it would provide for using feedback closed-loop and feedforward open loop algorithms in order adjusting the process targets based upon experimental or predicted behavior of the system.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner *Thomas Pham*; whose telephone number is (703) 305-7587 and fax number is (703) 746-8874, Monday-Thursday and every other Friday from 7:30AM- 5:00PM EST or contact Supervisor *Mr. Anil Khatri* at *(703) 305-0282.*

Any response to this office action should be mailed to: **Director of Patents and Trademarks Washington, D.C. 20231**, or **Hand-delivered** responses should be brought to **Crystal Park II, 2121 Crystal Drive Arlington, Virginia, (Receptionist located on the 4th floor),** or fax to the **official fax number (703) 872- 9306.**

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

Thomas Pham
Patent Examiner

TP

September 30, 2003

ANIL KHATRI
SUPERVISORY PATENT EXAMINER